

THE GENUS CALLINECTES.

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THE GENUS *Callinectes* was formed by Stimpson in 1860¹ for the reception of the species of Portunidae having a narrow or L-shaped abdomen in the male, and the merus of the outer maxillipeds short, sharply prominent, and curved outward at its antero-external angle. In this genus he places "the common American *Lupa diacantha*" (Latreille), and for want of sufficient material is unable to find constant differences between the northern and southern varieties of this species, or even to separate Pacific Coast specimens, regarding as doubtfully distinct *L. bellicosa*, which he had recently described from Guaymas.

In 1863 Lieut. Albert Ordway² published comparative descriptions of nine different species of *Callinectes*.³ Say's name *hastatus* was given to the common species of eastern North America, the name *diacanthus* was restricted to a Brazilian form described by Dana in 1852, and six new species were added. Mr. Ordway claimed that there were well-marked characters separating the species, the variations in the abdominal appendages of the male being of primary importance.

In 1869 Prof. S. I. Smith gave the name *C. danae* to Dana's *C. diacanthus*.

A. Milne-Edwards in his revision of the Portunidae⁴ did not recognize the validity of the genus *Callinectes*, but later⁵ he considered it as distinct and placed in it *Lupa diacantha* (Latreille), the one species embracing all the *Callinectes* of America and West Africa. The species described by Say, Stimpson, Smith and Ordway were recognized simply as varieties or races, the characters separating them being considered of trivial importance and not constant. To these varieties or races he added five others, three of which were made on slight characters.

¹ Ann. Lye. Nat. Hist. N. Y., VII, p. 220.

² Afterwards Brig. Gen. Albert Ordway of volunteers.

³ Boston Journ. Nat. Hist., VII, pp. 568-579.

⁴ Arch. Mus. Hist. Nat. Paris, X, Addenda, 1861.

⁵ Crustacés de la Région Mexicaine, 222, 1879.

In 1879 Kingsley described a species, *C. dubia*, from the west coast of Nicaragua. In 1893 Mr. James E. Benedict added *Callinectes tumidus*, var. *gladiator*, from the west coast of Africa.

I have reduced the number of the above species by two, the *C. pleuriticus* of Ordway and *C. dubia* of Kingsley being based on young specimens of *C. arcuatus*. I have changed the name *Callinectes hastatus* to *Callinectes sapidus* and have added a new subspecies, *C. sapidus acutidens*.

De Geer¹ was perhaps the first naturalist to represent a *Callinectes*. Under the name "Crabe de l'océan," he described in very general terms a swimming crab which he supposed identical with *Cancer pelagicus* of Linnaeus, but which Ordway considered synonymous with Gibbes' *Lupa sayi*. Figures 8, 9 and 11 correctly represent neither of these species, nor are they applicable to any species of *Callinectes*, while, on the other hand, Figure 10 shows the narrow abdomen characteristic of that genus.

Bosc² describes the habits of the common edible crab and the methods of taking it; but calls it³ by the name of another species, *Portunus hastatus*, translating a description given by Fabricius instead of describing the specimens he has seen.

Say was the first to give an unmistakable description of our northern *Callinectes*, calling it *Lupa hastata*, thereby confusing it with the Linnaean *Cancer hastatus*, a different species of *Lupa*, from the Mediterranean. That he undoubtedly meant to redescribe the known species is evidenced by the phrase, "In addition to the particulars already stated by naturalists of its manners." Say also redescribed *Lupa pelagica* (Linnaeus), but the name of his form of that species was soon changed by Gibbes to *Lupa sayi*. It is evident that in like manner the specific name *hastata* should be retained solely for the Linnaean form. It does not alter the case that the European and American species are now placed in different genera.

After Say, Latreille was the only writer to give a name to our species. In 1825⁴ he described *Portunus diacantha*, but unfortunately confused several species under this name. As the variety he mentions as having been sent from Philadelphia, in which "les quatre dents du front sont réunies et ne forment qu'un lobe largement échancré," is undoubtedly our common *Callinectes*, his typical form must be a different species. The terms "flavescente, maculis rubris, elongatis" and "un verdâtre-obscure en devant" are strongly suggestive of the southern *Callinectes bocourti*. In any case, the name *diacanthus* is not available for the common northern form.

Besides the collection in the United States National Museum, I have been permitted, through the kindness of Dr. Walter Faxon and Prof.

¹ Mémoires pour servir à l'Histoire des Insectes, VII, 427, pl. xxvi, figs. 8-11, 1778.

² Hist. Nat. Crust., I, pp. 212-214. 1801-1802.

³ Page 219.

⁴ Encyc. Méth. Hist. Nat., Entom., X, 190.

S. I. Smith, to examine a number of specimens in the Museum of Comparative Zoology of Harvard University and the Peabody Museum of Yale University. I am indebted to Prof. C. C. Nutting for permission to notice a specimen of *C. danae* from Cuba, collected by the Bahama expedition of the State University of Iowa in 1893, and owned by that institution. The approximate number of specimens of each species examined is as follows:

Specimens of Callinectes examined.

Name of species.	Number of specimens.	Name of species.	Number of specimens.
<i>C. sapidus</i>	300	<i>C. bocourti</i>	20
<i>C. ornatus</i>	200	<i>C. toxotes</i>	30
<i>C. danae</i>	100	<i>C. bellicosus</i>	70
<i>C. arcuatus</i>	70		
<i>C. larvatus</i>	100	Total.....	910
<i>C. tumidus</i>	20		

Only in working over a large amount of material is it possible to judge whether the characters separating nearly related forms are invariably coexistent, or whether they are modifications dependent on environment, or simply individual variations. In the present case I have been able to verify Ordway's classification, which was necessarily based on a limited number of individuals.

The value of the differentiation of the generative organs in determining species, has for some time been recognized. It is well exemplified in *Callinectes*. In *C. sapidus*, our common edible species, and the only species north of Cape Hatteras, the appendages of the first abdominal segment in the male reach as far as the tip of the last segment. This is also the case in *C. bocourti*, of the tropical Atlantic, and *C. toxotes* from the Pacific. In *C. arcuatus* and *C. bellicosus* of the west coast, they reach or nearly reach the terminal segment, but not the extremity; while in *C. ornatus*, *C. danae* and *C. tumidus*, they stop at the middle of the penultimate segment, and in *C. tumidus* are curved at the tips. In *C. larvatus* the appendages are noticeably short, reaching slightly beyond the proximal end of the penultimate segment.¹

These variations in the length and form of the appendages are accompanied by other differences, such as the shape and sculpture of the carapace, the outline of the front and lateral teeth, the length of the lateral spine, the granulation of the chelipeds, and the form of the abdomen in both sexes. These differences are specific. In species where the appendages are similar in length and position, no confusion need arise, owing to the other widely different characters possessed by

¹Brocchi (Ann. Sei. Nat., Zool., (6) II, 1875) claims to have examined a large number of specimens of "*Neptunus diacanthus*" from widely different localities, and finds only two distinct forms of appendages, long and short, which are coincident with only one other character, the outline of the front. He suggests the formation of two species based on these characters.

these species. *C. bocourti*, with its front of four rounded lobes and long narrow intramedial region, could not be confounded with *C. sapidus*; while the unusually wide intramedial region of *C. ornatus* will serve to distinguish it from any other species yet known. A little practice in observing the peculiarities of the carapace will enable one to determine with ease the species of young individuals down to at least one inch in width.

ANALYTICAL KEY TO THE SPECIES OF *CALLINECTES* EXAMINED.

- A. Inner supraorbital fissure closed.
- B. Frontal teeth two *sapidus* (p. 352).
- B'. Frontal teeth four.
- C. Appendages of first abdominal segment of male much shorter than the abdomen.
- D. Lateral spine more than twice the length of preceding tooth.
- E. Intramedial region broad, its anterior width about three times its length *ornatus* (p. 356).
- E'. Intramedial region narrow, its anterior width about twice its length.
- F. Appendages of first abdominal segment of male greatly exceeding the third segment.
- G. Appendages with tips straight. Second to sixth antero-lateral teeth equilateral *dane* (p. 357).
- G'. Appendages with tips curved. Antero-lateral teeth with posterior margins longer than anterior *arcuatus* (p. 362).
- F'. Appendages exceeding the third segment but little, or not at all. *larvatus* (p. 358).
- D'. Lateral spine less than twice the length of preceding tooth. *tumidus* (p. 359).
- C'. Appendages reaching the extremity of abdomen, or nearly so.
- D. Antero-lateral region granulate. Lateral spine between two and three times length of preceding tooth *toxotes* (p. 363).
- D'. Antero-lateral region smooth. Lateral spine less than twice preceding tooth *bocourti* (p. 360).
- A'. Inner supraorbital fissure open *bellicosus* (p. 365).

CALLINECTES SAPIDUS, new name.

(Plates XII; XXIV, fig. 1; XXV, fig. 1; XXVI, fig. 1; XXVII, fig. 1.)

Lupa hastata, SAY, Journ. Acad. Nat. Sci. Phila., I, pp. 65, 443, 1817 (not *L. hastata*, DESMAREST, 1823, nor MILNE-EDWARDS, 1834).

Lupa dicantha, DE KAY, Nat. Hist. N. Y., Zool., Part VI, Crust., p. 10, pl. III, fig. 3, 1841.

Callinectes hastatus, ORDWAY, Boston Journ. Nat. Hist., VII, p. 568, 1863.—SMITH, Rept. U. S. Commr. Fish and Fisheries, 1871-1872, p. 548 (1874).

Callinectes hastatus, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 224, 1879 (variety of *Callinectes diacanthus*).

Adult.—Carapace moderately convex. Granules of medium size, crowded on the inner branchial and cardiac regions, scattered and faintly marked on the anterior half of the carapace. The length of the

intramedial region is about one-half its anterior width.¹ The frontal or interantennal teeth are two, triangular, acute, with faint indications of two others on their oblique inner margins (Plate XXIV, fig. 1). The median subfrontal spine is conical and strong. The inner supraorbital tooth is broad and bilobed, the lobes obtuse, the outermost very prominent. The adjoining fissure is closed except at the anterior extremity, where there is a shallow V-shaped opening. The lateral teeth are concave on both margins and acuminate. Lateral spine in males from three to about four times the length of the preceding tooth.² Inner suborbital tooth acute. Penultimate segment of abdomen of male (Plate XXV, fig. 1) much constricted in its proximal half, widening at both extremities. Terminal segment obtuse, lateral margins convex proximally, slightly concave or straight distally. Appendages of first segment³ (Plate XXVI, fig. 1) reaching nearly to or beyond the extremity of the abdomen, near together for their proximal half, with only a slight outward curve; distal portions widely divergent except at tips. The abdomen of the adult female (Plate XXVII, fig. 1) is very broad, the margins of the last three segments separately convex; terminal segment longer than wide. Costæ of carpus and manus with depressed granules or often almost smooth to the eye.

Medium-sized specimens.—Carapace narrower than in adults; granules more distinct, especially on the anterior half. Frontal teeth less acute. Antero-lateral teeth broader, their margins more or less convex. Lateral spine a little more than twice the length of preceding tooth. Inner suborbital tooth broader, obtuse. Costæ of carpus and manus more distinctly granulate.

In very young males the abdominal appendages are much shorter, reaching only to the middle of the penultimate segment.

Size.—Adult males vary in width from $6\frac{1}{4}$ to $7\frac{3}{8}$ inches; adult females from 5 to 7 inches.

¹The transverse dimension of the intramedial region, or that division of the gastric region posterior to the second granulate ridge, I have designated as its width. Ordway does so under *C. torotes*, but uses the opposite term under *C. ornatus*. Thus the intramedial region of both he describes as long and narrow, which is misleading, the two species being entirely different in this respect.

²Measurements are made from the tips of the spine and tooth to the inner end of the intervening sinus; thus the spine is measured on its anterior margin, the tooth on its posterior margin.

³In both sexes of *Callinectes* the first abdominal segment is almost entirely concealed beneath the carapace; thus the abdomen in the male consists of five segments, the third, fourth and fifth normal segments being coalesced, the first and second being furnished with appendages. In the female there are seven segments, the second, third, fourth, and fifth with appendages. In Plates XXV and XXVII the first two segments are not shown.

*Measurements of Callinectes sapidus.*¹

Catalogue number.	Sex.	Length. Width.		Length of lateral spine.	Length of posterior lateral tooth.
		<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
4946.....	Male.....	79	185	18	6.5
5280.....	Female.....	64	176	28	6.8
17976.....	Female.....	54	124	12.2	5.2

Locality.—*Callinectes sapidus* is common in bays and at the mouths of rivers from Cape Cod to Texas, and is especially abundant in Chesapeake Bay. Beyond these limits it is of rare occurrence. It is found occasionally in Massachusetts Bay,² and a single individual is recorded from the Millpond, an inlet of Salem Harbor.³ Three specimens in the National Museum are from brackish water at Sing Sing, New York, collected by Prof. S. F. Baird. The following localities from which specimens have been examined are also worthy of notice:

Jamaica: U. S. Fish Commission (No. 7679, U. S. N. M.); Kingston Harbor (No. 17976, U. S. N. M.), Dr. R. P. Bigelow; mouth of Rio Cobre, fresh water (No. 18244, U. S. N. M.), Dr. R. P. Bigelow.

Bermudas: Bickmore (Mus. Comp. Zool.).

Brazil: Rio Grande; Capt. Harrington, June, 1861 (Mus. Comp. Zool.).

A fossil *Callinectes* (Plate XXVIII) was picked up on Gaugatha Beach, Accomac County, Virginia, September, 1894, by Mr. James P. Lucas, of Baltimore. It may have come from the extensive Miocene beds along that coast. The outline of the carapace is not preserved. The ventral surface indicates that the species is very near, if not identical with, *C. sapidus*, although the penultimate segment of the abdomen is narrower than is commonly seen in that species, and the median groove of the sternum is deeper and longer.

Southern specimens of *C. sapidus* show a tendency to develop sharper teeth or spines. This deviation culminates in two lots of specimens from Brazil, which I designate as a subspecies.

CALLINECTES SAPIDUS ACUTIDENS, new subspecies.

(Plates XIII; XXIV, fig 2.)

In this subspecies the carapace is wider and all the prominences are more strongly marked than in the typical *C. sapidus*. The areolations are separated by deeper depressions, the granules are more raised, the gastric ridges are stronger and more sinuous. There is a transverse granulate ridge on the cardiac lobes. The frontal teeth are narrower and more acute, and there are two small intervening teeth (Plate XXIV, fig. 2). Subfrontal and suborbital spines acuminate. Lateral teeth broad at base, narrowing abruptly to long, acuminate tips; margins

¹ The length is measured from the median sinus of the front.

² Smith, Rept. U. S. Commr. Fish and Fisheries, 1871-1872, p. 548 (1874).

³ C. Cooke, Amer. Nat., I, p. 52, 1867.

granulate. Last two teeth very long, adding to the effect of width, and making the antero-lateral margin less arcuate. Lateral spine very long, much longer than in *C. sapidus* of equal size, more than three times the length of the preceding tooth. Abdomen as in the species. Costæ of cheliped very prominent and strongly granulate. The granules of the inner margin of the merus extend upon the upper surface of the distal half. There are two carpal spines, one at the outer angle and a shorter one close to the propodal spine.

Size.—Length to sinus, 49 mm.; total length, 50.8; width, 121; length of lateral spine, 16; of preceding tooth, 5.

Type locality.—Santa Cruz, Brazil: Thayer expedition (Mus. Comp. Zool.); 1 male.

Two smaller males from Rio de Janeiro, Thayer expedition (Mus. Comp. Zool., and No. 19083, U.S.N.M.), resemble the type. The frontal and antero-lateral teeth are less acuminate, but the areolations are as strong and the lateral spine equally long.

In Nicaragua Mr. Charles W. Richmond collected a series of specimens which are intermediate between *C. sapidus* and typical *C. sapidus acutidens*. In the largest specimen, a male (Plate XIV) from Escondido River, September 6, 1892 (No. 18630, U. S. N. M.), the proportion of the carapace is as in typical *C. sapidus*. The areolation and granulation of the front are as in *C. sapidus acutidens*. The antero-lateral teeth are very acuminate, but not so slender as in *C. sapidus acutidens*, and the last two teeth are not so long. The lateral spine is less than three times the length of the preceding tooth, and slopes backward. The carpus has a spine close to that on the manus. The upper surface of the manus has not the conspicuous granulation of typical *C. sapidus acutidens*, although granules can be seen with the lens. A lot of four medium-sized specimens (1 male and 3 females, No. 18246, U. S. N. M.) were obtained at Greytown. In these the areolation and granulation are as in No. 18630, the frontal and lateral teeth are less sharp, the spine is much shorter, as in the young of typical *C. sapidus*, and is directed forward. In the Museum of Comparative Zoology there are three males of medium size, without locality, which resemble those from Greytown.

Size of male (No. 18630, U.S.N.M.).—Length to sinus, 53.5 mm.; total length, 56; width, 126; length of lateral spine, 14.3; of preceding tooth, 5.

Were the differences between the Brazilian and the Central American forms to prove constant in a large series of specimens, it might be best to call the latter by a different name.

Besides the subspecies, the only specimen of *C. sapidus* from Brazil that I have seen is a large and old male in the Museum of Comparative Zoology, labeled "Rio Grande, Brazil; Capt. Harrington, June, 1861." This specimen is very near the typical *C. sapidus*, although the lateral spine is directed backward and the frontal teeth are somewhat concave on their outer side.

CALLINECTES ORNATUS, Ordway.

(Plates XV; XXIV, fig. 3; XXV, fig. 2; XXVI, fig. 2; XXVII, fig. 2.)

Callinectes ornatus. ORDWAY, Boston Journ. Nat. Hist., VII, p. 571, 1863.—SMITH, Trans. Conn. Acad. Sci., II, p. 8, 1869.*Callinectes ornatus*, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 225, 1879 (variety of *Callinectes diacanthus*).

Carapace more convex than in *C. sapidus*; depressions shallow; length of intramedial area much less than half its anterior width. Surface finely and more evenly granulated than in *C. sapidus*. Frontal teeth four; the two outer obtuse, margins slightly concave; inner teeth small (Plate XXIV, fig. 3). Subfrontal tooth a prominent spine. Suborbital tooth a broad arcuate lobe. Lateral teeth shallow and broad; margins convex at base, concave in the terminal half; posterior margins longer than anterior; tips acute in the first 5 or 6 teeth, acuminate in the remainder. Lateral spine about two and one-half times the preceding tooth, directed forward. Abdomen of male (Plate XXV, fig. 2) narrower than in *C. sapidus*. Penultimate segment widest at the proximal end; margins slightly concave. The appendages (Plate XXVI, fig. 2) reach midway of the length of the penultimate segment; proximally they curve inward and touch or overlap each other; the distal portions are straight and divergent. At about one millimeter from the extremity, the appendage widens a little and then narrows rather abruptly to the very slender tip. The abdomen of the female (Plate XXVII, fig. 2) is very broad at the proximal end and tapers more rapidly to the terminal segment than in any other species.

Size.—Adult males vary in width from $4\frac{3}{4}$ to $4\frac{1}{2}$ inches; adult females, from $3\frac{3}{4}$ to $4\frac{1}{4}$ inches.

Measurements of Callinectes ornatus.

Catalogue number.	Sex.	Length to sinus.	Total length.	Width.
2076.....	Male.....	<i>mm.</i> 54	<i>mm.</i> 56	<i>mm.</i> 120
7584.....	Female.....	46.5	48	106

The localities of specimens examined are as follows:

South Carolina: East end Sullivan's Island oyster bed, Charleston; Joe White-side and C. C. Leslie (No. 3185, U. S. N. M.).

Bermudas: G. B. Goode (No. 3175, U. S. N. M.); Dr. F. V. Hamlin (No. 4028, U. S. N. M.).

Florida: Big Pine Key, H. Hemphill (No. 14889, U. S. N. M.); Key West, various collectors; Marco, H. Hemphill (No. 18231, U. S. N. M.); Punta Rassa, C. W. Ward (No. 5753, U. S. N. M.); Bird Key, schooner *Grampus* (No. 15216, U. S. N. M.).

Bahamas: Andros Island and Andros Bank, in sponges (F. A. Stearns collection). Cozumel, shore in net; str. *Albatross* (No. 9557, U. S. N. M.).

Jamaica, Dr. Smith (No. 2448, U. S. N. M.); str. *Albatross* (No. 18227, U. S. N. M.)

St. Thomas, A. H. Riise (No. 2457, U. S. N. M.).

Sabanilla, United States of Colombia; str. *Albatross* (No. 18228, U. S. N. M.).

Curacao; str. *Albatross* (No. 7584, U. S. N. M.).

Cumiana, Venezuela; Capt. Couthouy (Mus. Comp. Zool.).

Brazil: Maranhão, F. E. Sawyer (No. 18232, U. S. N. M.); Victoria, Hartt and Copeland, Thayer Expedition (Mus. Comp. Zool.).

Ordway records this species also from the Tortugas and Haiti.

Variations.—Brazilian specimens vary a little from typical specimens in the form of their antero-lateral teeth; the posterior margins instead of being concave are straight or slightly convex; the teeth, in consequence, do not appear so shallow. In other respects these specimens are typical *C. ornatus*.

CALLINECTES DANÆ, Smith.

(Plates XVI; XXIV, fig. 4; XXV, fig. 3; XXVI, fig. 3; XXVII, fig. 3.)

Lupa dicantha, DANA, Crust. U. S. Expl. Exped., I, p. 272, 1852, pl. XVI, fig. 7, 1855 (not *Lupea dicantha*, MILNE-EDWARDS, 1834).

Callinectes diacanthus, ORDWAY, Boston Journ. Nat. Hist., VII, p. 575, 1863.

Callinectes Danae, SMITH, Trans. Conn. Acad. Sci., II, p. 7, 1869.

Callinectes diacanthus, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 226, 1879 (variety of *Callinectes diacanthus*).

In general appearance resembles *C. ornatus*. The intramedial region is, however, much narrower. The front has two distinct median teeth, small and subacute; lateral teeth narrow, acute. The front resembles that of *C. ornatus*, but the median teeth are more prominent, the lateral teeth narrower (Plate XXIV, fig. 4). The teeth of the lateral margin are different from those of any other species with which it is associated. The second to the sixth inclusive do not trend forward as in *C. ornatus*, *C. larratus*, and *C. tumidus*,—that is, the posterior margin of the teeth is not much longer or more convex than the anterior. The teeth are acute, the seventh and eighth especially so; the eighth tooth is directed forward. Lateral spine more than three times the length of the preceding tooth. Suborbital tooth rather long and narrow. Penultimate segment of male abdomen (Plate XXV, fig. 3) very broad at proximal end. The appendages (Plate XXVI, fig. 3) reach to the middle or beyond the middle of the penultimate segment. They sometimes touch each other proximally, but more often are separated. In length they approach those of *C. ornatus*, but in *C. danae* the appendages taper regularly and do not widen near the tip. The abdomen of the female (Plate XXVII, fig. 3) is similar to that of *C. ornatus*, but wider in its fifth and sixth segments. Costæ of chelipeds very closely set with fine granules interspersed with larger ones. Very small specimens of this species can be separated from *C. ornatus* by the narrower intramedial region, and from *C. larratus*, which they superficially resemble, by the outline of the lateral teeth and the longer spines.

Size.—The largest males are from 5 to 5½ inches wide. The females are much smaller; the largest is 3¾ inches; one with eggs is 3¾ inches

wide. The dimensions of Dana's type in the National Museum (No. 2371) are: Length to sinus, 55.5; greatest length, 57.5; width, 131.5 mm. Length of Cuban specimen, to sinus, 54.5; greatest length, 56.3; width, 127 mm.

The localities of specimens examined are as follows:

- Bahia Honda, Cuba, May 8, 1893; Bahama Expedition of the State University of Iowa.
 Jamaica: str. *Albatross* (No. 18237, U. S. N. M.); Kingston Harbor, Dr. R. P. Bigelow (No. 17977, U. S. N. M.).
 Old Providence; str. *Albatross* (No. 18238, U. S. N. M.).
 Aspinwall; str. *Albatross* (18239, U. S. N. M.). Caught at night with a small hoop-net baited and set at a little distance from the steamer in four fathoms.
 Sabanilla, United States of Colombia; str. *Albatross* (No. 7559, U. S. N. M.).
 Brazil: Pernambuco, C. F. Hartt (Peabody Mus. Yale Univ.); Rio de Janeiro, U. S. Exploring Expedition, types of Dana's *Lupa dicantha*, 1 male (No. 2371, U. S. N. M.), 1 male (Mus. Comp. Zool.); Rio de Janeiro, Thayer Expedition (Mus. Comp. Zool.), very abundant; Santos, Thayer Expedition (Mus. Comp. Zool.).

Recorded by Smith from Bahia.

CALLINECTES LARVATUS, Ordway.

(Plates XVII; XXIV, fig. 5; XXV, fig. 4; XXVI, fig. 4; XXVII, fig. 4.)

- ? *Neptunus marginatus*, A. MILNE-EDWARDS, Arch. Mus. Hist. Nat. Paris, X, 318, pl. xxx, fig. 2, 1861.
Callinectes larratus, ORDWAY, Boston Journ. Nat. Hist., VII, p. 573, 1863.—SMITH, Trans. Conn. Acad. Sci., II, p. 9, 1869.
Callinectes larratus, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 225, 1879 (variety of *Callinectes diacanthus*).
Callinectes larratus, var. *africanus*?, BENEDICT, Proc. U. S. Nat. Mus., XVI, 1893, p. 537.

Areolations well marked; granules coarse; length of intramedial area a little less than one-half its anterior width. Front four-toothed (Plate XXIV, fig. 5); median teeth small, more prominent than in *C. ornatus*; lateral teeth obtuse, broader and more arcuate than in *C. ornatus*. Suborbital tooth prominent, arcuate, curved upward. Antero-lateral margin little arched. The teeth are well separated by deep rounded sinuses; the second to the fifth, inclusive, have convex posterior margins; the first three or four teeth are obtuse, the remainder sharp-pointed. Lateral spine between two and two and a half times the length of preceding tooth. Terminal portion of abdomen of male slender. Penultimate segment (Plate XXV, fig. 4) wider at proximal than at distal end, margins slightly concave. Appendages very short, overreaching the third segment but little or not at all (Plate XXVI, fig. 4). The abdomen of the female (Plate XXVII, fig. 4) is much narrower than in any other species; terminal segment much longer than wide. Costæ of manus prominent, with medium granules.

Size.—The width of full-grown males varies from $4\frac{1}{4}$ to $4\frac{3}{4}$ inches. The largest female is about 4 inches wide.

Measurements of *Callinectes larratus*.

Catalogue number.	Sex.	Length to sinus.	Entire length.	Width.
2142.....	Male.....	mm. 52	mm. 54.3	mm. 120
2142.....	Female.....	44.3	46	102

The localities from which specimens have been examined are as follows:

Florida: Long Key (No. 14890, U. S. N. M.); near Indian Key (No. 14032, U. S. N. M.); Big Pine Key (No. 14892, U. S. N. M.); Key West, various collectors; Tortugas (Nos. 2097, 2142, U. S. N. M.).

Bahamas; New Providence, str. *Albatross* (No. 17948, U. S. N. M.).

San Domingo; W. M. Gabb (No. 4172, U. S. N. M.).

Jamaica: Cozumel; Old Providence; Sabanilla, United States of Colombia; Curaçao, str. *Albatross*.

St. Thomas; A. H. Riise (No. 2446, U. S. N. M.).

Brazil: Rio Grande do Norte, Thayer Expedition (Mus. Comp. Zool.); Rio Vermelho, Bahia, R. Rathbun, Hartt Explorations, 1875-77 (carapace of young specimen).

Porto Grande, St. Vincent, Cape Verde Islands; United States Eclipse Expedition, 1889, one young female without chelipeds.

Africa, United States Eclipse Expedition, 1889: Baya River, Elmina, Ashantee (No. 14878, U. S. N. M.); St. Paul de Loando (No. 14877, U. S. N. M.).

Recorded from Vera Cruz, Mexico, by A. Milne-Edwards.

Neptunus marginatus, A. Milne-Edwards, as Professor Smith has pointed out, was probably based on an immature female of a *Callinectes*. It is from "Côte du Gabon," West Africa.

CALLINECTES TUMIDUS, Ordway.

(Plates XVIII; XXIV, fig. 6; XXV, fig. 5; XXVI, fig. 5; XXVII, fig. 5.)

Callinectes tumidus, ORDWAY, Boston Journ. Nat. Hist., VII, p. 574, 1863.

Callinectes tumidus, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 226, 1879 (variety of *Callinectes diacanthus*).

Carapace very convex; depressions deep; length of intramedial area no more than half its anterior width. Frontal teeth (Plate XXIV, fig. 6) four, triangular, tips rounded, the two median large and prominent, but not so far advanced as the lateral. Submedian tooth short, exceeding the front but little. Suborbital lobe rounded. Antero-lateral margin very arcuate. Lateral teeth broad, the first six very convex on their posterior margins and obtuse, the next two acute. Of the eight teeth, the fifth is the largest; the sixth and seventh are next in size. Lateral spine less than twice the length of the preceding tooth. Penultimate segment of male abdomen (Plate XXV, fig. 5) similar in shape to that of *C. ornatus*, but much shorter. Appendages (Plate XXVI, fig. 5) reaching to about the middle of the penultimate segment, the tips incurved. In the abdomen of the female (Plate XXVII, fig. 5) the penultimate segment is shorter than the fifth, and its margins are very arcuate. The spine at the distal end of the merus and the carpal spine are almost

obsolete, being replaced by blunt prominences. There is a blunt tooth on the anterior margin of the carpus just below the inner angle. Costae of manus coarsely and sparingly tuberculate. In specimens larger than the one photographed (Plate XVIII), the lateral spine is proportionally shorter and the chelipeds much heavier.

Size.—Adult males measure $4\frac{5}{8}$ and $4\frac{7}{8}$ inches in width, with a length of $2\frac{1}{2}$ inches. An adult female is $4\frac{1}{16}$ inches wide and 2 inches long.

Measurements of Callinectes tumidus.

Sex.	Locality.	Length to sinus.	Entire length.	Width.
		<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
Male.....	Victoria.....	60.5	63	126
Male.....	Cannavieras.....	59.5	62	116
Female.....	Long Key.....	50.5	52.5	103

The localities where this species has been taken are as follows:

Florida: Long Key, H. Hemphill (No. 14087, U. S. N. M.); Key West (Mus. Comp. Zool.); Tortugas, J. B. Holder (No. 2143, U. S. N. M.).

Jamaica; str. *Albatross* (No. 18236, U. S. N. M.).

Old Providence; str. *Albatross* (No. 7541, U. S. N. M.).

Brazil. Thayer Expedition (Mus. Comp. Zool.): Rio Grande do Norte; Victoria and Cannavieras, Hartt and Copeland.

Recorded from Haiti by Ordway.

CALLINECTES TUMIDUS GLADIATOR, Benedict.

Callinectes tumidus, var. *gladiator*, BENEDICT, Proc. U. S. Nat. Mus., XVI, 1893, p. 537.

Distinguished from *C. tumidus* by its longer lateral spine and less convex carapace. The abdominal appendages are curved as in typical *C. tumidus*, and the front and lateral teeth correspond to that species.

Type.—Small male from Beyah River, Elmina, Ashantee, Africa, U. S. Eclipse Expedition, 1889 (No. 14879, U.S.N.M.).

CALLINECTES (?) BOCOURTI, A. Milne-Edwards.¹

(Plates XIX; XXIV, fig. 7; XXV, fig. 6; XXVI, fig. 6; XXVII, fig. 6.)

Callinectes bocourti, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 226, 1879 (variety of *Callinectes diacanthus*).

? *Callinectes cayennensis*, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 226, 1879 (variety of *Callinectes diacanthus*).

? *Callinectes africanus*, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 229, 1879 (variety of *Callinectes diacanthus*).

¹The brief description given by A. Milne-Edwards corresponds to the specimens which I have referred to this species. An individual labeled "*Callinectes bocourti*, A. M. Edwards, Belize, Honduras," recently received from the museum at Paris, is an undoubted *C. dana*. I am loath, however, to make *C. bocourti* a synonym of *C. dana* until I am assured that the specimen was correctly labeled, in which case the species here called *C. bocourti* must receive a new name.

Very convex; areolations prominent; coarsely granulate except along the lateral margin, where the carapace is smooth. Intramedial region very long, its length about equal to its posterior width. Front (Plate XXIV, fig. 7) with four large rounded teeth, the median the smaller, and a little less advanced than the lateral, except in a few cases where they project as far as the lateral. Suborbital tooth short, triangular, narrow, obtuse. Antero-lateral teeth very broad, acute, the last two or three spiniform. Lateral spine short, usually less than twice the length of the preceding tooth. Penultimate segment of the abdomen in the male (Plate XXV, fig. 6) constricted in its proximal portion, widening at both extremities. Terminal segment long. Appendages (Plate XXVI, fig. 6) reaching to the end of the abdomen, with a double curve as in *C. sapidus*; tips crossing. The sternum has a deep longitudinal groove in front of the abdomen. The abdomen of the female (Plate XXVII, fig. 6) is very long, especially the penultimate segment; the terminal segment is much longer than wide. Costæ of chelipeds with depressed granules, often appearing almost smooth to the eye. The carpal and the anterior meral spine are usually normal, though sometimes in old specimens reduced to blunt projections. There is a broad blunt tooth on the anterior margin of the carpus just below the inner angle.

Size.—The largest male is $5\frac{1}{2}$ inches wide; the largest female, $4\frac{1}{2}$ inches.

Measurements of Callinectes bocourti.

Catalogue number.	Sex.	Length to sinus.	Entire length.	Width.	Spine.	Last tooth.
		<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
18233.....	Male.....	56	57.5	114	9.5	5.2
18234.....	Male.....	69.5	72.5	140	10	7
Cannavieras (M. C. Z.).....	Female.....	57.5	60	124	12 a	5 a

a Tip broken.

Color.—Alcoholic specimens indicate that the color is rich and variegated. In a large male from Sabanilla, the carapace is greenish, darker in the anterior half, and especially on the gastric region. The posterior half is yellowish-green, the yellow being most apparent on the inner half of the branchial region. There are four oblong red spots following the outline of the frontal and antero-lateral margin, but at a little distance from the teeth. There are blotches of red on the cardiac and branchial regions. The transverse lines of granules crossing the carapace are also red. The chelipeds are a purplish brown. In a large male from Greytown the central and antero-lateral portions are brown, the yellow branchial spots are brighter than in the preceding, and there is a tinge of blue along the posterior margin. Smaller specimens are duller in color, but all show traces of red and yellow spots.

The specimens examined are from the following localities:

Greytown, Nicaragua; C. W. Richmond, March 27, 1892 (No. 18231, U. S. N. M.).
Turbo, Isthmus of Panama (Atlantic side); Dr. Maack (Mus. Comp. Zool.).

United States of Colombia: Sabanilla, str. *Albatross* (No. 18235, U. S. N. M.);
 Carthagea, Atrato Expedition, Dr. A. Schott (No. 2460, U. S. N. M.).
 Brazil: Para, Cannavieras and Itabapana, Thayer Expedition (Mus. Comp.
 Zool.); Maranhão, Lieut. F. E. Sawyer, U. S. N. (No. 18233, U. S. N. M.).

The type locality of *C. bocourti* is Rivière de Mullins, 20 miles south of Belize, Honduras; of *C. cayennensis* is Guiana.

The small sterile female from Aspinwall described by Ordway¹ doubtless belonged to this species. The specimen, however, is not extant. The only very young specimen I have examined is a female 1½ inches wide, in which the lateral teeth are not widely separated as in adults, but their margins are in contact at base, the posterior edges of the teeth considerably longer than the anterior. The median frontal teeth are proportionally larger than in adults, smaller and more advanced than the lateral.

A single smaller male specimen labeled "*Callinectes africanus* (A. M. Edwards), Senegal" has lately been received from the museum at Paris. Without further evidence I am not able to say that this species differs from *Callinectes bocourti*. The median teeth of the front are less advanced than the lateral; the lateral spine is about twice the length of the adjacent tooth. Length of carapace 18.5; width 36 mm. The type locality of *C. africanus* is Cape Verde Islands. As the range of *Callinectes larvatus* includes these islands and the African coast, it is not improbable that others of our American species are also found there.

CALLINECTES ARCUATUS, Ordway.

(Plates XX; XXIII, fig. 1; XXIV, fig. 8; XXV, fig. 7; XXVI, fig. 7; XXVII, fig. 7.)

Callinectes arcuatus, ORDWAY, Boston Journ. Nat. Hist., VII, p. 578, 1863.

Callinectes pleuriticus, ORDWAY, Boston Journ. Nat. Hist., VII, p. 578, 1863.

Callinectes arcuatus, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 228, 1879 (variety of *Callinectes diacanthus*).

Callinectes pleuriticus, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 228, 1879 (variety of *Callinectes diacanthus*).

Callinectes dubia, KINGSLEY, Proc. Boston Soc. Nat. Hist., XX, p. 156, 1879.

Callinectes, sp., SMITH, Third Ann. Rept. Peabody Acad. Sci., 1870, p. 91 (1871).

Carapace very convex, finely granulate; granules very numerous in the median region. Length of intramedial region about one-half its anterior width; length greater than in *C. danae*. Front with four stout, triangular, blunt teeth, the middle pair about one-third the size of the outer pair (Plate XXIV, fig. 8). Subfrontal spine exceeding the lateral frontal teeth but little. Suborbital tooth rounded. Antero-lateral margin very arcuate; teeth large, well separated, those nearest the orbit subacute, becoming sharp and spinous toward the lateral spine, which is between two and three times the length of the adjoining tooth. Penultimate segment of male abdomen broad at base; margins subparallel for the greater part of their length (Plate XXV, fig. 7). Appendages (Plate XXVI, fig. 7) reaching or nearly reaching the last

¹ Boston Journ. Nat. Hist., VII, p. 575.

segment of the abdomen, slightly curved at the tip in the adult. Abdomen of female (Plate XXVII, fig. 7) with fifth segment much narrower distally than proximally, and shorter than sixth. Costæ of manus coarsely granulate. The three carpal spines mentioned by Ordway (he had but one specimen) are present in some of the smaller specimens, but are not equal, and in older specimens the anterior two are more or less rudimentary.

Small specimens are less convex and more prominently areolated than the adult. The large frontal teeth are wider. A single medium-sized individual taken by the *Hassler* at Panama (Mus. Comp. Zool.) has unusually long spines, between three and a half and four times the length of the next tooth.

Size.—The largest male is about $4\frac{3}{8}$ inches wide. The largest female is $4\frac{5}{8}$ inches; one bearing eggs is $3\frac{7}{8}$ inches wide, and has the lateral spine strongly curved forward. Most of the specimens examined are small.

Measurements of Callinectes arcuatus.

Sex.	Length to sinus.	Width.
Male.....	<i>mm.</i> 55.5	<i>mm.</i> 119
Female.....	55	118

Specimens have been examined from the following localities:

Lower California and Gulf of California. U. S. Fish Commission str. *Albatross*, 1889: San Bartolome Bay, Lower California (No. 15433, U. S. N. M.); Conception Bay, mouth of Rio Mulege (No. 15432, U. S. N. M.); Algodones Lagoon, Mexico (many small specimens, No. 15431, U. S. N. M.); Horseshoe Bend, Colorado River (No. 15434, U. S. N. M.).

Cape St. Lucas (type locality); John Xantus (Mus. Comp. Zool.).

Guaymas, Mexico; H. F. Emeric (No. 14854, U. S. N. M.).

Acapuleo, Mexico; Hassler Expedition (Mus. Comp. Zool.).

Gulf of Fonseca; J. A. McNeil (Mus. Comp. Zool.). Types of *C. dubia*, Kingsley.

Panama (type locality of *C. pleuriticus*); Received from Mus. Comp. Zool. (No. 18511, U. S. N. M.).

Callinectes arcuatus and *C. danae* are perhaps more closely related than any other two species of *Callinectes*. The front of *C. arcuatus* has the median pair of teeth sharper and more prominent, the lateral pair broader, and the submedian tooth shorter than in *C. danae*. The anterolateral margin is more arcuate, and its teeth directed forward instead of outward. Terminal segment of abdomen in male shorter than in *C. danae*, and appendages of first segment longer, and curved instead of straight at the tips.

CALLINECTES TOXOTES, Ordway.

(Plates XXI; XXIV, fig. 9; XXV, fig. 9; XXVI, fig. 9; XXVII, fig. 8.)

Callinectes toxotes, ORDWAY, Boston Journ. Nat. Hist., VII, p. 576, 1863.

Callinectes toxotes, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 227, 1879 (variety of *Callinectes diacanthus*).

Callinectes robustus, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 227, 1879 (variety of *Callinectes diacanthus*).

Carapace very large, coarsely granulate; areolations very prominent. Cardiac region distinctly divided into two lobes by a median furrow. Intramedial area narrow, its length greater than its posterior width. Front (Plate XXIV, fig. 9) slightly upturned, with four broad rounded lobes, the inner pair the smaller and less advanced, and more deeply separated from each other than from the lateral. Submedian tooth small; in the males about as much produced as the outer frontal teeth; in the single female at hand, it is less advanced than the front. Suborbital teeth obtuse. The antero-lateral teeth are triangular, with a short closed fissure between their bases; margins denticulate. The second, third and fourth teeth are almost equilateral and acute; the fifth to the eighth inclusive are acuminate, with successively longer tips, which in the seventh and eighth curve forward. The lateral spine is from two and one-third to nearly three times the length of the preceding tooth. Sternum flat. The penultimate segment of the abdomen of the male (Plate XXV, fig. 9) is constricted in its proximal half, but not so much so as in *C. sapidus* and *C. bocourti*. The appendages (Plate XXVI, fig. 9) reach almost to the extremity of the terminal segment and are more strongly curved than in *C. sapidus* or *C. bocourti*. Abdomen of female (Plate XXVII, fig. 8) similar to that of *C. bocourti*, but the penultimate segment is shorter. The spines on the anterior or inner margin of the merus are strongly curved. Spines of the manus long-pointed. The costae are very coarsely tuberculate.

Size.—This is the largest species known, attaining a width of $7\frac{1}{2}$ or 8 inches. The largest specimen examined is from Cape St. Lucas, and is in the Museum of Comparative Zoology. Length to sinus, 83 mm.; to tip of frontal teeth, 86; width, 191; length of lateral spine, 21; of preceding tooth, 7.3. This specimen is like old specimens of *C. sapidus* in having the lateral teeth narrower, sharper, and with more concave margins than in younger specimens. The median frontal teeth are also more slender. The frontal teeth are so much worn that their real relative lengths can not be seen; but in all other specimens the median are not so advanced as the lateral, the difference being greater in the smaller specimens.

The only young specimens are three, a male and two females, which were without label in the Mexican exhibit at the World's Columbian Exposition. They have the branchial regions very much swollen, and the posterior margins of the antero-lateral teeth are longer than the anterior. They approach no other known species.

The localities from which specimens have been examined are as follows:

Cape St. Lucas (type locality): John Xantus, 2 large males, 1 ovigerous female (Mus. Comp. Zool.); one dried fragmentary specimen (No. 2413, U. S. N. M.), having the carapace marked in Stimpson's handwriting, "*C. diacanthus*, Cape St. Lucas, Xantus," and bearing no other label.

Acapulco, Mexico (No. 18507, U. S. N. M.). A large number were collected by the Hassler Expedition, and are in the Museum of Comparative Zoology. They are all adult, the smallest being 108 mm. wide.

Mexico; Mexican Commission, World's Columbian Exposition (No. 18631, U. S. N. M.).

Guayaquil, Ecuador; Prof. James Orton; one male (Peabody Mus., Yale Univ.).

The *C. robustus* of Milne-Edwards, which I think was based on worn examples of *C. toxotes*, is recorded from the Pacific coast of the United States of Colombia.

CALLINECTES BELLICOSUS (Stimpson).

(Plates XXII: XXIV, fig. 10; XXV, fig. 8; XXVI, fig. 8.)

Lupa bellicosa (SLOAT MS.) STIMPSON, Ann. Lyc. Nat. Hist. N. Y., VII, p. 57, 1859.

Callinectes bellicosus, ORDWAY, Boston Journ. Nat. Hist. VII, p. 577, 1863.

Callinectes bellicosus, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 227, 1879 (variety of *Callinectes diacanthus*).

Carapace moderately convex, granules fine and very closely set. Areolations less distinct than in *C. arcuatus*. Length of intramedial region less than one-half its anterior width. Front (Plate XXIV, fig. 10) with two slender sharp teeth, widely separated, and between them two very faintly marked median teeth. Submedian tooth sharp, longer than the lateral pair. The inner supraorbital fissure is open, often throughout its length. Border of the orbit outside the fissure advanced beyond that portion inside the fissure. Suborbital tooth slender, well advanced and sharp. Antero-lateral teeth with sides more or less concave and sharp white tips. The lateral spine is very short; in adults less than twice the length of the preceding tooth, in half-grown specimens about twice the length, and in young specimens more than twice. The penultimate segment of the abdomen of the male (Plate XXV, fig. 8) is broad at the base, and constricted in its proximal half. The appendages reach nearly to the extremity of the penultimate segment; they have a double curve (Plate XXVI, fig. 8), the curve being stronger in a vertical direction than in a horizontal. The merus of the chelipeds has four spines on its inner margin; a fifth spine, grading in size and position with these, is situated on the condyle of the ischium. The ridge on the outer and upper margin of the manus is very prominent and marked with large tubercles, which in one nearly full-grown male are spiniform. The other costae of the manus are less strongly marked, and are often almost smooth.

Size.—The largest male is $5\frac{5}{16}$ inches wide, or 134 mm., with a length to the sinus of 64 mm. The frontal spines are broken. The largest females are immature or sterile, having a triangular abdomen. The dimensions are as follows: Length to sinus, male 46 mm., female 42; entire length, male 48 mm., female 43.5; width, male 97 mm., female 86.

The localities from which specimens have been examined are as follows:

Lower California and Gulf of California. U. S. Fish Commission Str. *Albatross*, 1889: San Bartolome Bay; Magdalena Bay; La Paz Harbor; San Josef Island; Carmen Island; Concepcion Bay; Guaymas; San Luis Gonzales Bay; St. George's Bay; Shoal Point, Colorado River.

La Paz, Lower California; L. Belding (No. 4630, U. S. N. M.).

Nearly all the specimens collected by the *Albatross* are young.

Ordway gives as the locality for this species "Pinicate Bay, Gulf of California, Mus. S. I." The type is not extant.

CALLINECTES NITIDUS, A. Milne-Edwards.¹

Callinectes nitidus, A. MILNE-EDWARDS, Crust. Rég. Mex., p. 228, 1879 (variety of *Callinectes diacanthus*).

Callinectes diacanthus, var. *Callinectes nitidus*, A. MILNE-EDWARDS, Crust. Rég. Mex., explanation of pl. XLI, 1879.

Callinectes diacanthus, A. MILNE-EDWARDS, Crust. Rég. Mex., pl. XLI, 1879.

In this *Callinectes* the carapace is broad and the antero-lateral borders form a curve of a large circle; the teeth are large and strong. The front is little advanced; its median teeth are rudimentary, separated from each other by a well-marked notch, below which can be seen the projection of the epistome, which is very prominent. The carapace is ornamented with very fine granulations, and has a more shining appearance than ordinary. The abdomen of the male is narrow; in all the examples which I have examined the penultimate article has a membranous articulation at its base. The intromittent organs of the male are slender, straight, and extend to near the extremity of the penultimate article of the abdomen.

The carapace is violet; the under side a grayish-yellow, with the exception of the abdomen of the female, which is rose color, and has a black band on each article. The feet are tinged with blue and red. The plate was colored after a sketch made of the living animal by M. Bocourt. The Paris Museum possesses a large number of *Callinectes* from Chile, which resemble completely those of Guatemala.

Abundant at Tanesco, Guatemala, on the borders of the Estéros, hidden in the sand.

DEFORMITIES.

On Plate XXIII are shown three deformed claws of *Callinectes sapidus* in the collection of the National Museum. They are different from those figured by Lucas² and by Faxon.³

In a right claw from the Potomac River (fig. 4), received from J. F. H. Sisson, there is a duplication of the dactylus and the index finger, the inner pair being complementary to the outer and not a repetition of the right dactylus and index finger. The outer pair are simple and have each one row of teeth; the inner pair are forked near the tips; the dactylus has one row of teeth continued on both forks; the index finger is broader and has two rows of teeth converging to its base, each row terminating at the tip of a fork.

In a left claw from Willoughby Point, Virginia (fig. 3), the index is divided into two branches, one above the other. The lower branch corresponds in length to the dactylus and has an upper row of teeth:

¹ This species is known to the writer only from Milne-Edwards' description.

² Ann. Soc. Entom. France (2) II, pl. 1, fig. 1.

³ Bull. Mus. Comp. Zool., VIII, pl. n. fig. 5.

the upper branch is much shorter and curved inward at the extremity; it has a row of teeth on both the upper and lower margins of its outer surface.

In a left claw from the same locality (fig. 2) the index is normal; the dactylus is abruptly bent downward at the middle, forming a sort of heel, and then turned obliquely forward, and carries but one row of teeth.

In a lot of *Callinectes sapidus* from Indianola, Texas, there is a remarkable series of malformations of the abdomen. One male, 54 mm. long, has the penultimate segment widening gradually toward the antepenult, which for its distal two-thirds has almost straight sides, instead of being concave as usual. Another male, 51.5 mm. wide, has broader segments than the last, and they are seven in number, as in the female. A very small male, 24 mm. wide, has the abdomen still wider proportionally, but the sutures between the third, fourth and fifth segments less distinct. Another individual, 55 mm. in width, has the abdominal appendages of the male, but the shape of the abdomen is more nearly related to that of the female than any of the above. The first five segments are broad, as in the female, but the fifth and sixth narrow rapidly toward their union, making the sixth subcircular. The appendages of the first segment reach to the middle of the sixth, and are very divergent distally. Attached to one side of the third segment is a foreign growth, probably *Peltogaster*.

Most of the young females in this lot have the usual triangular abdomen with straight sides, and the fourth, fifth and sixth segments soldered together. One, however, no larger than the others, has an abdomen with convex sides and segments coalesced; the genital orifices are not present. A female of about the same size is in all respects like adult forms.

In the Museum of Comparative Zoology there is a female *Callinectes sapidus*, about 85 mm. wide, with circular abdomen, bearing, besides the usual appendages, a pair on the first segment similar to those common to the male.

HABITS AND ECONOMIC VALUE.

In "The Fisheries and Fishery Industries of the United States,"¹ Mr. Richard Rathbun gives an account of the habits, distribution, and market value of *Callinectes hastatus* (now *C. sapidus*), reviewing all that has been written on the subject down to that date.

In "Notes on the Crab Fishery of Crisfield, Maryland,"² Dr. Hugh M. Smith deals very fully with the industry at that place, including the modes of capture, methods of preparation for the market, etc.

In recent reports and bulletins issued by the United States Fish

¹ Section I, Natural History of Useful Aquatic Animals, pp. 775-778, 1881.

² Bulletin U. S. Fish Commission, No. IX, p. 104, 1889.

Commission¹ can be found tabular statements showing the number and value of edible crabs taken in each State.

It is not yet known whether any other species of *Callinectes* than *sapidus* is brought to market, but as both *C. ornatus* and *C. larvatus* are abundant in the Gulf States, they are undoubtedly taken for this purpose. It would be interesting to know to what extent these and other species take the place of *C. sapidus*, and how they differ in habits, color,² etc.

OBSERVATIONS UPON THE HABITS OF *CALLINECTES SAPIDUS*.

Three correspondents of the National Museum—Hon. John D. Mitchell, of Victoria, Texas; Judge Benjamin Harrison, of Pensacola, Florida; and Mr. Willard Nye, jr., of New Bedford, Massachusetts—have kindly permitted me to insert here the following notes based on personal observation of *Callinectes sapidus*. The facts presented by Mr. Mitchell regarding the shedding are of especial interest, as our knowledge concerning the frequency of this occurrence is very meager.

Notes by John D. Mitchell.—Born on an isolated point on the Bay, and inheriting the naturalist's instincts from my mother, I made this crab (*Callinectes sapidus*) one of my earliest playthings, and it has been an interesting study since. When full grown, it measures about 7 inches from point to point of the shell in the male, and 5 inches in the female. The claws, legs, and shell of the male are tinted with blue, those of the female with red: the apron of the male is narrow, that of the female is broad. The mother crabs live in the Gulf and in the deep water passes and bayous adjacent to the Gulf. The eggs begin growing in the spring under the apron, and hatch the latter part of May or June, the young clinging to the apron for several days. When first hatched, they are very little more than two eyes, and look like anything but a crab. I know little about the number of times the crab sheds from the time of leaving the mother's apron until it gets its crab shape, which is inside of three months. I have seen the little fellows so thick near the margin that the water would look murky and thick, and thousands could be scooped in the two hands placed together, and their cast-off shells would form a gray streak along the water's edge. They collect in immense numbers along protected shores and nooks, shedding several times and getting their shape in September, when they

¹Statistical Review of the Coast Fisheries of the United States. < Rept. U. S. Commr. of Fish and Fisheries for 1888 (1892). Report on the Fisheries of the New England States, by J. W. Collins and Hugh M. Smith. < Bull. U. S. Fish Commission, X, 1890 (1892). Report on the Fisheries of the South Atlantic States, by Hugh M. Smith. < Bull. U. S. Fish Commission, XI, 1891 (1892). A Statistical Report on the Fisheries of the Gulf States, by J. W. Collins and Hugh M. Smith. < Bull. U. S. Fish Commission, XI, 1891 (1892). Report on the Coast Fisheries of Texas, by Charles H. Stevenson. < Rept. U. S. Commr. of Fish and Fisheries for 1889-1891 (1893).

²H. W. Conn, in Johns Hopkins University Circulars, November, 1883, describes the color variation in the claws of the sexes of *C. sapidus* (= *hastatus*).

start on their great migration across the bays for the north shores, where they enter the creeks and estuaries and go upon the shoals, where they remain until grown, burying themselves in the mud and sand in winter.

They shed twice each summer for three summers, when they reach their full size and shed no more. The young crabs grow one-third larger after each shedding in the second and third summer. The newly shed crab is a great delicacy. The shedding is done mostly at night, the smaller ones coming very near the shore for that purpose. I have observed the process many times with the aid of a lantern, and have gathered many a mess of them, frequently waiting for some fellow to finish shedding. About ten minutes is occupied in the process, though I have never held a watch on one.

During the third summer the females are impregnated by old males, after which the red markings of the former appear, the apron becomes dark, and its form changes from triangular to broadly ovate. After impregnation and shedding for the last time, the females start for the Gulf and meet the males no more, one meeting being sufficient for life. They lay their first eggs in their fourth summer. The males remain among the growing crabs, and are the ones taken for the table.

The average life of the male crab is as follows: Take him in his third summer, his shell is 5 inches, and he has some green and blue tints, and occupies the place among crabs that a 16-year-old boy does among men. He selects a safe place for his last shedding (he sheds twice during the summer), generally about September, near an old log, stone, or something of the kind. Failing to find anything, he will dig a place in the sand, 12 or more inches in diameter. After shedding and going through his calisthenic performance to get himself into shape, his shell is 7 inches wide, and the woman's form on his back becomes prominent, though it is always discernible on the young ones. It takes him the balance of the season to get back his strength and harden his flesh. The colors, green, brown, blue and white, are clear and bright, and the crab is very pretty. He comes back to the shallows in the spring of his fourth year, a little sobered in color, but in his best condition. He has two objects in life, eating and propagation. He eats anything he can get in the way of dead fish or flesh. He will eat the young of his own species, if he can catch them. I have seen him make a rush among fiddlers feeding near the water, catch one, and take it back to the water to devour it.

In courting he is ludicrous to the onlooker. The breeding females are those in their third summer. Meeting or approaching one of these, he will elevate himself on the tips of his legs, getting as high from the ground as possible, extend his claws to their widest extent, supporting himself with his paddles, and in this position he will strut slowly and pompously in front of her. Should another male appear, a battle ensues. The sexual act lasts from 3 to 6 hours. The female will accept

the male any time during her third summer, and as she sheds twice during this time, it frequently happens that he finds her while in a soft condition, taking possession just the same. Woe betide the luckless young male he finds too soft to run! There will be one soft crab less and one old male will have a good dinner. There is no sentiment about *C. sapidus*.

How long the male lives I do not know for certain, but I think about four years from his last shedding, which would make his entire life seven years. When he becomes superannuated, he seeks quiet nooks and safe shallows and prepares for death. In the fall (October and November) I have found numbers of these old fellows scarcely able to move and too feeble to bite; their flesh is all gone or is soft and watery, and evaporates when dead or the minnows soon clean it out. A day or so after death, if the waves do not wash them to pieces, the shells are as clean and empty as any cast-off shell. I think this is the kind of shell which, occasionally found, gives rise to the idea that the crab sheds after maturity. It sheds to grow and for no other purpose, and when through growing it is through shedding.

I have seen full-grown females with a triangular apron, perhaps about three each summer, and have always known them as neuters. Many specimens are deformed in the fingers. This I attribute to the accident of losing them, followed by some sort of pressure on the new fingers before they have become hard—as, for instance, in a sudden fright they might exert them over shells or other hard substances and permanently bend them. I remember one adult male whose claws were crossed at the points, and another in which the points worked past each other like a pair of shears. The fingers and claws that are renewed after losing the original ones are never so large or so effective as the original ones. This recuperative power lasts in full force only during the growing years and diminishes with age. A middle-aged crab will reproduce a claw only half the size of the original, and an old crab will reproduce none, or only a small nub that is useless.

There is no one, I think, engaged in the crab fishery on this coast. Occasionally the negroes of Port Lavaca will send a few dozen boiled to the interior towns and retail them at 10 cents each. Mr. F. V. Gentry, of Port Lavaca, has shipped a few lots of adult crabs, but there is no one making a specialty of catching them. I believe he paid 25 cents per dozen.

I have seen *Callinectes sapidus*, or what I took to be them, in the Guadalupe River at Victoria; in the Navidad River, Jackson County, 20 miles above Texana; and I caught three, which were *C. sapidus*, in a spring branch which flows into the Garcitas Creek, Victoria County. They were 40 miles from salt water, air line. They were different in color from those in salt water, being of a reddish brown; otherwise I saw no difference in them.

On November 14, 1894, while seeking stone crabs in the mouth of

Chocolate Bay, near Port Lavaca, I found in deserted stone-crab holes four soft crabs, *Callinectes sapidus*,—one female in her second year, one male in his second year, one male in his third year, and one male in his fourth year, or full grown. I also found four aged crabs, too feeble to run or nip. They had sought a quiet nook, protected by rushes and salt grass, and were patiently awaiting dissolution. I attribute the late shedding to our late fall. We had had no frost, and wading was very pleasant.

The third week of September, 1895, I spent cruising in Matagorda and adjacent bays, and had another chance to observe the habits of these crabs. There is a cove, terminating in a small bayou, on the north side of Sand Point, Calhoun County; this point separates Matagorda and Port Lavaca bays. The weather was easterly and the cove protected. Around it we stretched a seine and caught about 200 adult male crabs, 22 of which had in their possession a female; 19 of these females were verging on maturity; 2 were shed for the last time (that is, full grown), but still soft, one of them being held upside down, and one female was full grown, her new shell about three days old. Twenty-one of these couples were interlocked in the same manner—that is, the male had his front leg on either side passed from the rear around the paddle and legs of the female, bringing her well in front of him, and held so tightly that many of them were lifted from the water and put into the boat without losing their hold. None released his companion until roughly handled. One was holding on to the sides of the seine with the rear feet and to his companion with his front feet, and was eating a small fish which was still alive. He held on to both fish and crab until placed in the skiff. In all the crabs observed—not far from 1,000—the only full-grown females were the three above described, of which two were yet soft and the third had shed very recently.

Notes by Benjamin Harrison.—On both the east and west coasts of Florida, *Callinectes sapidus* is quite common; nor is it confined to salt water. On the St. Johns River, it is found more than 100 miles from the sea. I have seen many specimens in Lake George, 125 miles from Jacksonville. On the west shore of Lake George a salt spring runs through a deep creek into the lake. Here the common crab swarms. Where the creek empties into the lake there is a wide expanse of shallow water with clean white sand. Here the crabs come out at night in great numbers to feed, and I have frequently seen them seize small fish and collect about the refuse from our camp. Evidently they have no distaste for the fresh water of the lake.

Both on the east and west coasts they like quiet, shallow waters, and prefer sandy bottoms. They bury themselves in the sand to escape observation, and will do this as soon as they find speed ineffective when pursued. During the spring months they are much more “in evidence,” because then they seek the waters near the shore warmed by the sun. While mating they are much less voracious than at other times. After

mating they are daring and predatory, soon regaining the strength and flesh they have lost.

Now each crab has a favorite retreat, from which he does not wander far. When chased, he returns to it. He has a regular beat, and he patrols it at short intervals day and night, except when gorged with food. If he finds a small bit, he will eat it immediately. If more than he wants at the moment, he will try to drag it to his sheltered nook under a log or rock. If he can not carry it, he will eat to repletion and then try to bury it, and will remain in the neighborhood. If food is discovered within the territory of one, others will cross the boundary, and I have seen lively fights. But as soon as the visitor gorges himself, he seems disinclined to active exertion and only "covers what he stands on," while another drives off the crowd and eats. I have often dropped in a dead fish and watched this performance. From what I have seen, I judge that the sense of smell is well developed in *Callinectes sapidus*. I have covered the fish, but it was soon found, and other crabs came from a distance. Undoubtedly they have keen sight, but they seem to depend more on their sense of smell. In the spring, when the male and female are together, there seems to be much community of feeling between the two. They hunt in couples; they do not struggle with each other for food, but share it, and I have many times seen the two combine to drive off a stranger. Later, however, they treat each other as strangers, and after April I have seen the two "partners" fight.

They retire to deeper water in winter. We see them return to their summer haunts every warm day. They do not seek the deepest water, but find shelter where the water is about 4 or 5 feet deep. They do not roam about at night-time till the water is quite warm. During December, January, February and March they must eat very little, yet they come out strong and active. Therefore, I think they "half-hibernate" (if I may use the expression) as the bears do in this State.

In 1890 I saw fully 500 sea bass in Lake George, through which the St. Johns River runs, which had died from the attack of a fungus-looking parasite. I found two crabs with the same disease. Both died. I saw many other crabs in the same waters apparently entirely free from any sickness.

I have seen the common leech on joints of the crab,¹ but never satisfied myself it was anything but a passenger. So of a red worm about 2 inches long. I was not sure in either case that the crab was attacked.

Notes by Willard Nye, jr.—The largest and oldest of our common blue-claw crabs I have generally found in some small pool in a marsh where the tide refreshed the water at each rise. Here, selecting a place under some rock or sunken drift log, the crab takes life in a most easy way, as with each tide the small fish swarm into the pool

¹The *Myzobdella lugubris* is a small leech, which lives on the "edible crab" (*Callinectes hastatus*), adhering to the soft membrane between the joints and at the base of the legs. (Verrill, Vineyard Sound Report, p. 458.)

to see what they can pick up, and many of them are taken in by crabby. Taking advantage of such spots in the sand or mud and keeping out of sight, and then roiling up the water, they attract these small fish and secure a good meal. After a crab has reached his extreme growth, I do not think he sheds his shell, as I have often found them with a long growth of moss on their backs. As October draws to a close, the blue-claw moves off into deep water, and at this season may frequently be seen paddling near the surface as he works downstream with the tide. They are found all winter in the channels near the mouths of our rivers, where the water is salty. In some places I have seen the ice covered with them, where they had been caught by people spearing eels. At this season they are very torpid. A number of years ago the September storms closed up the entrance of Quick Sands Pond, Rhode Island. Early in November there came a sharp cold spell, and on going down to where the washed-in beach made a dam to the creek, I think I saw more blue-claw crabs in five minutes than I have ever seen since in the whole of my life. The bottom was blue and green with them. For, you see, as the water became cold they moved down pond and tried to get back to the ocean the way they came in in the spring, and here in the shallow water you would see hundreds snapping their claws out to catch the young menhaden which, like themselves, had become imprisoned by the closing creek. These crabs were much more ugly than any I have seen, and if in catching them with a scoop net you broke the shell of one and he tried to get away, he was at once seized on by those nearest and eaten up without the slightest remorse. These crabs were so thick that with a single scoop of a small net I hauled out eleven. A few days after I was at the pond, the weather became much colder and the crabs started out over the beach to the ocean, a distance of about 400 feet. Some bass fishermen then caught over six barrels while the crabs were on their way across. This is the only instance which I ever knew of the blue-claw crab leaving the water and walking across lots on his own hook.

EXPLANATION OF PLATES.

PLATE XII.

Callinectes sapidus, Rathbun, = *C. hastatus* (Say). Male. Much reduced.

PLATE XIII.

Callinectes sapidus acutidens, Rathbun, new subspecies. Male. Reduced about one-fifth.

PLATE XIV.

Callinectes sapidus, varying toward *acutidens*. Male. Reduced about one-fifth.

PLATE XV.

Callinectes ornatus, Ordway. Male. Reduced about one-fifth.

PLATE XVI.

Callinectes danae, Smith. Male. (Type of *Lupa dicantha*, Dana.) Reduced about two-thirds.

PLATE XVII.

Callinectes larratus, Ordway. Male. Reduced about one-fifth.

PLATE XVIII.

Callinectes tumidus, Ordway. Male. Reduced about one-fifth.

PLATE XIX.

Callinectes bocourti(?), A. Milne-Edwards. Male. Considerably reduced.

PLATE XX.

Callinectes arcuatus, Ordway. Male. Reduced about one-fourth.

PLATE XXI.

Callinectes toxotes, Ordway. Female. Reduced about one-third.

PLATE XXII.

Callinectes bellicosus (Stimpson). Male. Reduced about one-fifth.

PLATE XXIII.

Fig. 1. *Callinectes arcuatus*, Ordway. Young male. (Perhaps type of *C. pleuriticus*, Ordway.) Reduced about one-fourth.

2-4. Deformed claws of *Callinectes sapidus*. Reduced about one-third.

PLATE XXIV.

Frontal outlines of *Callinectes*. Slightly enlarged.

Fig. 1. *Callinectes sapidus*.

2. *Callinectes sapidus acutidens*.

3. *Callinectes ornatus*.

4. *Callinectes danae*.

5. *Callinectes larratus*.

Fig. 6. *Callinectes tumidus*.

7. *Callinectes bocourti*.

8. *Callinectes arcuatus*.

9. *Callinectes toxotes*.

10. *Callinectes bellicosus*.

PLATE XXV.

Abdominal outlines of *Callinectes*. Male. Slightly enlarged.

Fig. 1. *Callinectes sapidus*.

2. *Callinectes ornatus*.

3. *Callinectes danae*.

4. *Callinectes larratus*.

5. *Callinectes tumidus*.

Fig. 6. *Callinectes bocourti*.

7. *Callinectes arcuatus*.

8. *Callinectes bellicosus*.

9. *Callinectes toxotes*.

PLATE XXVI.

Abdominal appendages of *Callinectes*. Male. Slightly enlarged.

- Fig. 1. *Callinectes sapidus*.
 2. *Callinectes ornatus*.
 3. *Callinectes danae*.
 4. *Callinectes larratus*.
 5. *Callinectes tumidus*.

- Fig. 6. *Callinectes bocourti*.
 7. *Callinectes arcuatus*.
 8. *Callinectes bellicosus*.
 9. *Callinectes toxotes*.

PLATE XXVII.

Abdominal outlines of *Callinectes*. Female. Slightly reduced.

- Fig. 1. *Callinectes sapidus*.
 2. *Callinectes ornatus*.
 3. *Callinectes danae*.
 4. *Callinectes larratus*.

- Fig. 5. *Callinectes tumidus*.
 6. *Callinectes bocourti*.
 7. *Callinectes arcuatus*.
 8. *Callinectes toxotes*.

PLATE XXVIII.

Fossil *Callinectes*. Natural size.